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The role of silver bream (*Blicca bjoerkna* L.) in the formation of ichthyocenoses of small water bodies in the Kaliningrad region

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Abstract. Structural parameters (frequency of occurrence, catches per unit effort in number and biomass) are considered, which make it possible to characterize the role of species in the ichthyocenosis and determine the ways of fishery exploitation of aquatic biological resources. The frequency of occurrence is analyzed as a structural parameter of the species structure of the ichthyocenosis and as a characteristic that allows one to determine the optimal mesh size of fixed gill nets. Data from 1.141 catches and 8.205 individuals were analyzed. A comparative analysis of the structural characteristics of silver bream in different types of water bodies of the Kaliningrad region was carried out using the example of Lake Marinovo, the Sokolniki Quarry and the Staraya Dam Pond. The frequency of occurrence of silver bream in the studied water bodies ranges from 56 to 73%. The frequency of occurrence of silver bream in fixed nets of different mesh reaches maximum values in fixed nets with mesh size of 14 to 30 mm in the Staraya Dam Pond and reaches high values in all studied water bodies in fixed nets with mesh size of 20 to 27 mm. With increasing mesh size, the frequency of occurrence of silver bream decreases, with the exception of the Sokolniki Quarry. In the studied water bodies, silver bream predominates in small-mesh fixed nets with a mesh size of 14-18 mm, with the exception of the Sokolniki Quarry, where the dominance of medium-sized silver bream (14-17 cm) was also noted. The silver bream is the "core of the ichthyocenoses" of the studied water bodies according to the three parameters studied and belongs to numerous species in terms of numbers and biomass. The size-weight and some biological indicators of the silver bream in the studied water bodies are similar. In these water bodies, the silver bream can be used as an object of amateur and sports fishing.

Keywords: inland waters of the Kaliningrad region, ichthyocenosis, silver bream, multi-mesh fixed nets, frequency of occurrence, catches per unit effort, species structure

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Научная статья

Роль густеры (*Blicca bjoerkna* L.) в формировании ихтиоценозов малых водоемов Калининградской области

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Аннотация. Рассматриваются структурные показатели (частота встречаемости, уловы на усилие в поштучном и весовом выражениях), позволяющие охарактеризовать роль видов в ихтиоценозе и определить пути рыбохозяйственной эксплуатации водных биоресурсов. Показатель частоты встречаемости анализируется как структурный показатель видовой структуры ихтиоценоза и как характеристика, позволяющая определить оптимальный шаг ячеи ставных сетей. Были проанализированы данные по 1 141 облову и 8 205 особям. Проведен сравнительный анализ структурных характеристик густеры в разнотипных водоемах Калининградской области на примере оз. Мариново, карьера Сокольники и пруда Старая Дамба. Частота встречаемости густеры в исследуемых водоемах колеблется от 56 до 73 %, с максимумом в пруду Старая Дамба. Частота встречаемости густеры в ставных сетях разной ячейности достигает максимальных значений в ставных сетях с шагом ячеи от 14 до 30 мм в пруду Старая Дамба и достигает высоких значений во всех исследуемых водоемах в ставных сетях с шагом 20–27 мм. С увеличением шага ячеи частота встречаемости густеры снижается, за исключением карьера Сокольники. В исследуемых водоемах преобладает густера в мелкоячейных ставных сетях с шагом ячеи 14–18 мм, за исключением карьера Сокольники, где также отмечено доминирование среднераз-

мерной густеры (14–17 см). Густера является «ядром ихтиоценозов» исследуемых водоемов по трем исследуемым параметрам и относится к многочисленным видам по численности и биомассе. Размерно-весовые и некоторые биологические показатели густеры в исследуемых водоемах имеют сходный характер. В исследуемых водоемах доминируют мелкоразмерные особи густеры. В данных водоемах густера может быть использована как объект любительского и спортивного рыболовства.

Ключевые слова: внутренние водоемы Калининградской области, ихтиоценоз, густера, разноячейные ставные сети, частота встречаемости, уловы на усилие, видовая структура

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Introduction

In recent decades inland water bodies of Kaliningrad region present a great interest from the point of view of its fishery exploitation. It is determined by the increasing importance of industrial and recreation fishing and aquaculture on these water bodies. Information support for the management of aquatic bioresources is required in order to identify ways of their fishery use. It includes obtaining ichthyological information about modern state of water bioresources, subsequent assessment of the total allowable catch or the recommended catch amount and the development of rules for regulating fishing.

The Kaliningrad region is rich by various types of small water bodies that are of fishing importance and can be involved in economic activity. The study of such water bodies can be considered from the point of view of each reservoir as separate fishery system and identifying the main structural relationships in both quantitative and qualitative representations. It makes possible to assess the promising possibilities for using these water bodies. The use of a system approach in fishery research contributes to an adequate description of the composition, structure and functions of the fishery system using a unified set of standard fishing parameters [1–4].

Therefore, the purpose of this article is to asses the role of the silver bream in the formation of ichthyocenosis of small water bodies of the Kaliningrad region on the basis of the structural characteristics of water bioresources in fishery systems using the example of Lake Marinovo, the Sokolniki Quarry and Staraya Damba Pond.

Material and research methods

During the period from 2020 to 2023 fisheries studies of 12 different types of inland water bodies of the Kaliningrad region (rivers, lakes, ponds, reservoirs, quarries) was carried out by the Department of Water Bioresources and Aquaculture (formerly the Department of Ichthyology and Ecology) of the Federal State Budgetary Educational Institution of Higher Education “Kaliningrad State Technical University”. All information is stored in the computer database system of information and analytical system “Rybvod” [1].

The methodological basis for the research was approaches to system analysis of fishery information, which includes structural analysis [1].

Two main indicators were analyzed: the frequency of occurrence of the species in the ichthyocenosis (Fq), the catch per unit effort in number (*Yn* / *f*), and the catch per unit effort in biomass (*Yw* / *f*). The volume of material was 8,205 fish specimens. The number of catches was 1,141. Catches with fixed nets with a mesh size of 12 to 40 mm were analyzed. The catch per one net of 25 m length per day was taken as the standard catch per unit effort for fishing nets.

Frequency of occurrence (Fq) was calculated as the ratio of the number of catches of the analyzed fishing net in which one or another species of organism was found (*n*), to the total number of catches of the analyzed fishing net (*N*), expressed as a percentage (formula):

$$Fq = n / N.$$

Research results and discussion

Frequency of occurrence of silver bream in the studied water bodies. The frequency of species occurrence characterizes the role of the species in the formation of fish community [1, 4-6]. This parameter can be considered both a structural characteristic of the species structure of the ichthyocenosis, and as a characteristic that allows one to determine the optimal mesh size in the analyzed fishing gear.

An analysis of the frequency of occurrence was carried out for fixed fishing nets in general and for each mesh size from 12 to 40 mm. The frequency of occurrence of silver bream in the studied water bodies exceeds 50%, reaching the highest values in the Staraya Damba Pond (Table).

Average frequency of occurrence of silver bream in studied water bodies

Water body name	Average frequency of occurrence, %
Sokolniki Quarry	56.3
Staraya Damba Pond	72.9
Lake Marinovo	56.7

An analysis of the frequency of occurrence of silver bream depending on the mesh size showed the complete dominance of small-sized silver bream in the presented different types of water bodies and an almost

twofold decrease of such indicator for medium-sized silver bream. Thus, the occurrence of silver bream in catches decreases with an increase of the mesh size in fixed fishing nets. The maximum values of frequency of occurrence of silver bream were noted in Staraya Damba Pond in fixed fishing nets with mesh size 14-30 mm. High values of this indicator (0.7-0.8) are typical for Lake Marinovo in fixed fishing nets with mesh size 14-27 mm and for the silver bream of the Sokolniki Quarry in fixed fishing nets with mesh size 20-40 mm (Fig. 1).

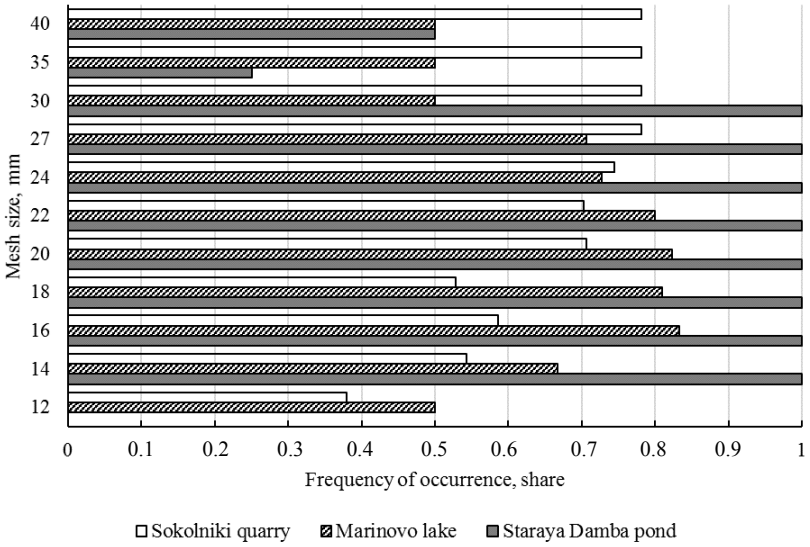

Fig. 1. Frequency of occurrence of silver bream in studied water bodies depending of the mesh size

This allows to conclude that silver bream of somewhat larger size is dominated in the Sokolniki Quarry in comparison with Lake Marinovo and Staraya Damba Pond.

Wider use of the frequency of occurrence parameter, noted in the works of L. A. Zhakov [6], based on the high values of this parameter, allows to conclude that silver bream is the "core of ichthyocenosis" of these water bodies.

Structural parameters of silver bream of Lake Marinovo. Lake Marinovo is located in the southeast of the Kaliningrad region and is a part of the Vyshtynets group of lakes. This lake belongs to the Pissa River basin. The area of the lake is 45 hectares. The maximum depth is more than 7 m [7, 8].

The species composition of the ichthyofauna of Lake Marinovo is represented by 8 species belonging to 3 families: cyprinids, percids and pike (Fig. 2).

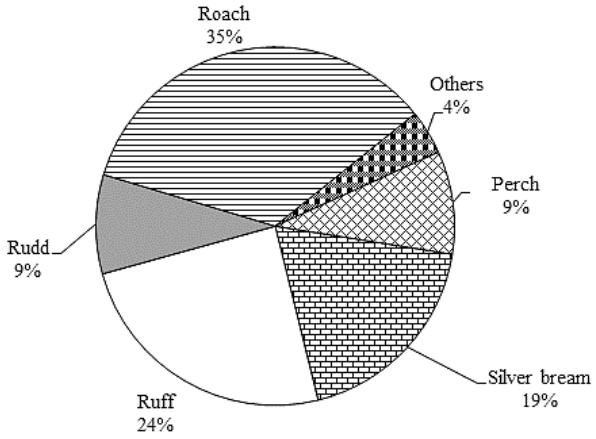

Fig. 2. Species structure of ichthyocenosis of Lake Marinovo (% by number)

The dominant position in the ichthyofauna is occupied by roach, ruffe and silver bream, in general accounting 78% in numbers and 42% in biomass. Such small-numbered species as pike, bream and tench were

combined into the group "other species", which accounting only 4% in numbers, but 55% in biomass. It can be explained by their representation of large-sized specimens but in peace quantities.

The size structure of silver bream of Lake Marinovo is presented by specimens ranging in length from 7 to 20 cm. Small-sized specimens ranging in length from 7 to 10 cm dominated and constitute about 60% of the total number of silver bream.

The highest values of catches per unit effort in number and biomass of silver bream of Lake Marinovo were in size groups of 8-10 cm and averaged 97 specimens per net per day and 1.0 kg per net per day respectively. Obtained results allow to conclude that the slam-size specimens of silver bream predominate in Lake Marinovo.

In accordance to the analysis of catches per unit effort (Fig. 3), the industrial use of silver bream of Lake Marinovo using fixed fishing nets of various mesh size shows that the largest catches per unit effort in number (*Yn / f*), ranging from 70 to 141 specimens per net per day, can be achieved using the fixed fishing nets with small mesh size ranging from 14 to 16 mm.

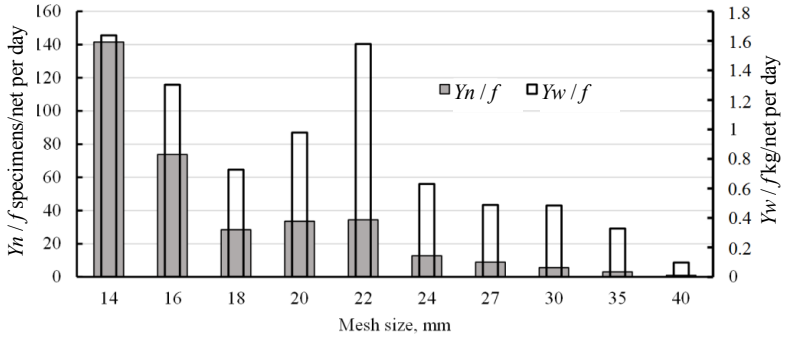

Fig. 3. Dependence of catch per unit effort of fixed fishing nets of silver bream of Lake Marinovo on mesh size

Maximum catches per unit effort in biomass (*Yw / f*) ranging from 1.16 to 1.30 kg per net per day were achieved also using fixed fishing nets with the same mesh size. This is consistent with the size structure of silver bream in this water body.

The size and weight parameters of silver bream increase with the growth of the fish. Females reach the maximum size at the age of 8 years, males – 7 years. The silver bream of Lake Marinovo matures at the age of 2-3 years when it reaches length 7-10 cm.

Structural parameters of silver bream of the Sokolniki Quarry. The Sokolniki Quarry is located in the central part of the Kaliningrad region, connected with the Pregolya River and has a depth of more than 10 m.

The ichthyocenosis of the Sokolniki Quarry is presented by 19 fish species and one fish-like species (river lamprey), belonging to 6 families: cyprinids (71% of the total number of species), percids, smelt, catfish, pike and lamprey (Fig. 4).

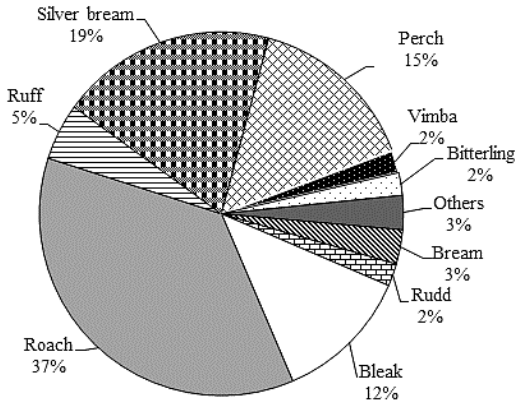

Fig. 4. Species structure of the ichthyocenosis of the Sokolniki Quarry (% by number)

Due to their small quantity species such a white-eye, chub, asp, dace, silver crucian carp, golden crucian carp, european smelt, tench, river lamprey, catfish, pike, ide were combined into the group "other species". The large species diversity in the Sokolniki Quarry is explained by its close hydrological connection with the Pregolya River. Four species take a leading position in ichthyocenosis: roach, silver bream,

perch and bleak. In general, they make up 83% by number and 70% by biomass. Silver bream is one of the numerous species in the ichthyocenosis both in number (19% of the total number) and in biomass (15% of the total biomass).

The size structure of silver bream of the Sokolniki Quarry is represented by size groups from 5 to 23 cm. The dominance of two size groups is noted: the first group corresponds to small-sized specimens (5, 7-11 cm) and the second – to medium-sized ones (14-17 cm).

According to the analysis of the catches per unit effort (Fig. 5), the industrial use of silver bream of the Sokolniki Quarry using fixed fishing nets with different mesh size shows that the highest catches per unit effort in number (*Yn / f*), ranging from 17 to 27 specimens per net per day, fall on fixed fishing nets with mesh size 16, 20 and 30 mm, which confirms the predominance of small-sized specimens in the water body.

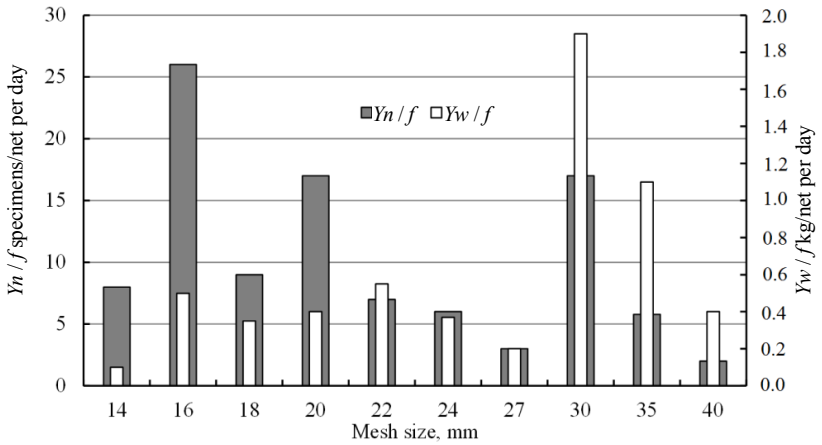

Fig. 5. Dependence of catches per unit effort (*Yn / f*, *Yw / f*) of silver bream of the Sokolniki Quarry on mesh size

Analysis of size and weight parameters shows that parameters of the silver bream increase with the growth of the fish. Maximum size (23 cm) specimens reach at the age of 8 years. Silver bream of the Sokolniki Quarry matures at the age of 2-3 years when reaching a length 7-9 cm. A predominance of females over males is noted.

Structural parameters of silver bream of the Staraya Damba Pond. The Staraya Damba Pond is located 15 km from the city of Kaliningrad. Its area is 47 hectares. The predominated depths are 4-7 m.

The ichthyofauna of the Staraya Damba Pond is presented by 10 species belonging to 3 families: cyprinids (70% of the total number of species), percids and pike (Fig. 6).

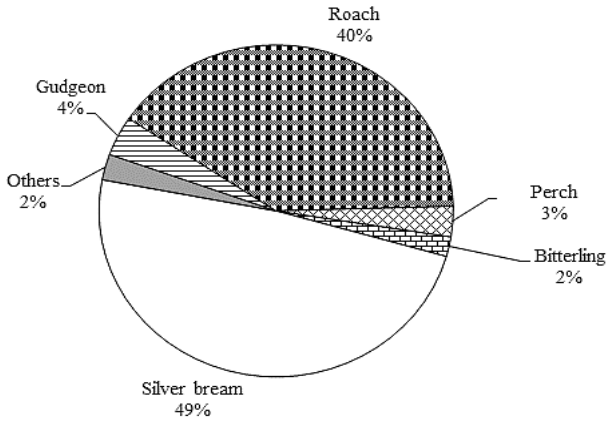

Fig. 6. Species structure of the ichthyocenosis of the Staraya Damba Pond (% by number)

Two species dominates in the ichthyofauna: roach and silver bream, accounting 89% in numbers and 58% in biomass. The “other species” group includes ruffe, silver crucian carp, rudd, bream, pike and freshwater perch due to their small quantity in this water body.

The size structure of the silver bream in the Staraya Damba Pond in accordance with catches per unit effort (*Yn / f*) is represented by size groups from 6 to 17 cm with predominance of small-sized specimens 7-9 cm long, constituting about 76% of the total number

of silver bream. The largest catches per unit effort in number (*Yn* / *f*) are 135-214 specimens per net per day and fall on size groups 7-9 cm. This indicates a significant dominance of small-size groups.

According to the analysis of catches per unit effort (Fig. 7) the industrial use of silver bream of the Staraya Damba Pond using fixed fishery nets with different mesh size shows that the highest catches per unit effort in piece terms (*Yn* / *f*), ranging from 550 to 720 specimens per net per day, can be achieved using fixed fishing nets with mesh size 14 and 18 mm.

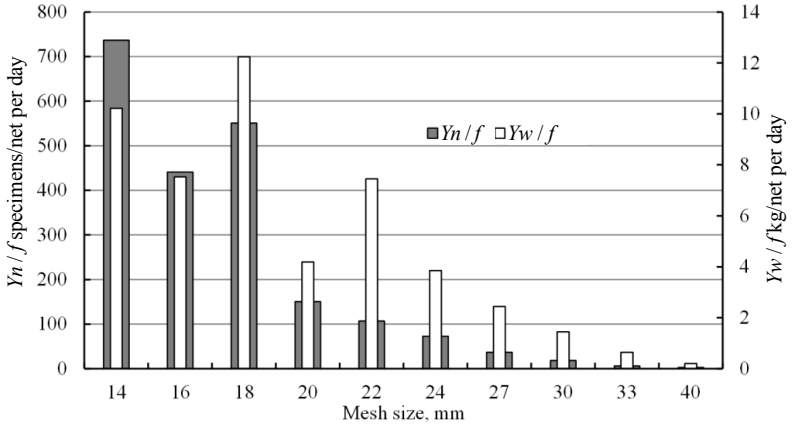

Fig. 7. Dependence of catches per unit effort of silver bream of the Staraya Damba Pond on mesh size

The size and weight parameters increase with the growth of the silver bream. The silver bream of the Staraya Damba Pond matures at the age of 2-3 years when it reaches length 7-8 cm. The predominance females over males in population is noted, which is typical for populations of silver bream in other water bodies of the Kaliningrad region [5].

Thus, the silver bream in investigated water bodies can be considered as an object primarily of amateur and sport fishing.

Conclusion

The analysis of the structural parameters of the silver bream of three different types of water bodies of the Kaliningrad region, which have fishery importance, made it possible to conduct a comparative structural analysis of its parameters and determine the main ways of using this object of water bioresources.

The silver bream is one of the most numerous species according to the three studied indicators in studied water bodies and constitutes the “core of ichthyocenosis” of these water bodies. The biological parameters of the silver bream from these different types of water bodies have similar characteristics.

The studies carried out shows that small-sized silver bream predominates in Lake Marinovo, the Sokolniki Quarry and the Staraya Damba Pond. But it doesn’t represent economic value from the point of view of its industrial usage. But this makes it possible to recommend its use as an object of amateur and sport fishing, to carry out various measures for fishery reclamation and to develop various areas of aquaculture.

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